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ABSTRACT

This document is intended to help mathematics teachers prepare students for the "exit exam of essential skills" required by the new Student Accountability Standards enacted by the North Carolina State Board of Education. Unlike current End of Grade and End of Course tests, the North Carolina High School Exit Exam (NCHSEE) focuses on skills across all disciplines, K-12, rather than specific content areas. Students should have the opportunity to practice and refine these skills in all courses. Within the NCHSEE, each of the four domains (Communication, Processing Information, Problem Solving, and Using Numbers and Data) addresses an aspect of what students should know and be able to do. The NCHSEE is an 8- to 100-item multiple choice test. The best preparation is mathematics instruction that provides students with multiple opportunities to experience problems constructed in real-life situations and that require multiple steps to a solution. The major mathematical skills and concepts tested are: (1) applying ratio, proportion, and percent; (2) analyzing data, identifying trends, and making predictions (3) applying formulas and algebraic expressions; and (4) computing with real numbers. Sample lessons and activities are included. (SLD)

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Instructional Strategies For Mathematics Teachers

Exit Exam 2002

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Public Schools of North Carolina
State Board of Education
Department of Public Instruction
Instructional Services
English Language Arts

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Exit Exam Instructional Strategies For Mathematics Teachers

Introduction

This document is intended to help mathematics teachers prepare students for the "exit exam of essential skills" required by the new Student Accountability Standards enacted by the NC State Board of Education.

The strategies included here are based on two essential premises:

- following the *NC Standard Course of Study* (SCS) will help students be successful and
- quality instruction will improve student achievement.

Unlike current End of Grade and End of Course tests, the North Carolina High School Exit Exam (NCHSEE) focuses on skills across all disciplines K-12 rather than specific content areas. Students should have the opportunity to practice and refine these skills in all courses.

Although the NCHSEE does not specifically address content knowledge, each course SCS complements the assessment through students' acquisition of knowledge and refinement of skills. The *North Carolina High School Exit Exam Matrices* (www.ncpublicschools.org/student_promotion/highschool.html) illustrate the correlation between NCHSEE objectives and the SCS. The course objectives, listed with a given NCHSEE objective, are not meant to be exclusive; other objectives may very well correlate to a given NCHSEE objective.

Teachers are encouraged to extend connections between the NCHSEE objectives and the learning goals within their instructional programs.

Within the NCHSEE, each of the four domains, Communication, Processing Information, Problem Solving, and Using Numbers and Data, addresses an aspect of what students should know and be able to do. Good classroom practices will integrate the objectives from the different domains. For example, a classroom activity might ask students to *process information* and *use data* in order to *solve a problem* and then *communicate* their solution to others.

The NCHSEE is an 80-100 item, multiple-choice test. While teachers may find multiple-choice tests useful at times, they should use a variety of classroom activities and assessments. Constructed response and performance assessments will strengthen students' use of the skills necessary for success on the NCHSEE and beyond.

Effective Instructional Strategies

The best preparation for the **NCHSEE** is mathematics instruction that provides students multiple opportunities to experience problems constructed in real-life situations and that require multiple steps to a solution.

The *major mathematical skills* and *concepts* tested are:

- applying ratio, proportion, and percent;
- analyzing data, identifying trends, and making predictions;
- applying formulas and algebraic expressions; and
- computing with real numbers.

The format of the exam will require students to *integrate mathematical ideas with applications from other content areas*. Students must be able to *read information* presented in *realistic contexts* and *design strategies* for finding solutions to the problems posed.

Students will need to *interpret* information presented from multiple sources (text, charts, tables, graphs, and formulas).

Teachers need to design instruction and daily activities that include written assignments requiring students to *construct* and *interpret* information in a realistic context. Students should:

- process and communicate information in written context;
- explain or elaborate on solutions from information in a written format; and
- analyze and evaluate information provided in a written format.

Problem solving should be a key component of the instructional program. Students should:

- complete tasks where the solution method is not known in advance;
- solve problems that arise in mathematics and other contexts.
- apply and adapt a variety of problem-solving strategies; and
- demonstrate understanding when assessed with problem-solving tasks.

Students need to use comfortably a variety of *mathematical representations*. Students should:

- organize and represent data appropriately;
- use various representations to clearly communicate mathematical ideas;
- translate among mathematical representations to solve problems; and
- model and interpret physical, social, and mathematical phenomena.

Classroom experiences need to emphasize the *interrelatedness* of mathematical ideas and *connections* to other subjects. Students should:

- recognize and use connections among mathematical ideas;
- communicate understanding of how related concepts build on each other; and
- solve problems that apply mathematics in contexts outside of mathematics.

Exit Exam Domains and Objectives

Domain 1: Communication

1. Learner will apply rules of standard English to written text.
2. Learner will use main ideas and supporting details to organize and communicate information.
3. Learner will evaluate ideas and information to make informed decisions.
4. Learner will listen carefully and thoughtfully to understand, evaluate, and synthesize information.
5. Learner will evaluate information by recognizing the author's purpose to draw conclusions or make informed decisions.
6. Learner will evaluate information to detect bias or vested interest.
7. Learner will follow instructions to draw conclusions or make informed decisions.
8. Learner will evaluate information to detect fact, propaganda, opinion, bias, or vested interest.

Domain 2: Processing Information

9. Learner will analyze information by comparing, contrasting, and summarizing to make informed decisions.
10. Learner will use patterns, relationships (e.g., cause and effect relationship), and trends to draw inferences and make predictions concerning environmental and social outcomes.
11. Learner will synthesize information from several sources to apply that information to a new situation.
12. Learner will organize tasks to accomplish an objective (e.g. scientific investigations).
13. Learner will evaluate information, explanations, or ideas by identifying and applying criteria to draw conclusions or make predictions.
14. Learner will interpret multiple sets of data to determine the best course of action.

Domain 3: Problem Solving

15. Learner will plan logical steps and organize resources to accomplish a task within a given time frame (e.g. investigation).
16. Learner will evaluate situations to determine conflict and resolution.
17. Learner will assess consequences of personal actions to determine legal, economic, political, environmental, and social impact.
18. Learner will analyze the roles of the executive, judicial, and legislative branches of the United States government to make informed choices, as a productive, contributing citizen.
19. Learner will interpret information about the United States economic system to make informed choices related to citizenship (legal, economic, political, environmental, and social impact) and personal standard of living.
20. Learner will apply elementary principles underlying mechanical, electrical, thermal, or chemical systems to make inferences.
21. Learner will determine the best economic value of several alternatives to make informed choices.

Domain 4: Using Numbers and Data

22. Learner will apply real number operation and relationships (e.g., absolute value, radical expression, exponents) to solve problems related to home, work, and environment.
23. Learner will apply formulas and expressions (e.g., area, perimeter, circumference, surface area, volume, Pythagorean Theorem, similar polygons, angle relationships) to solve problems related to home and work.
24. Learner will make predictions and inferences by using algebraic concepts (e.g., tables, charts, algebraic equations, and coordinate graphs) to solve problems related to work, scientific investigations, and consumer issues.
25. Learner will make predictions and inferences by using data analysis and probability (e.g., measures of central tendency, regression equations, theoretical probability) to solve problems related to home, scientific investigations, and work.
26. Learner will use relationships among fractions, decimals, and percents to demonstrate understanding of mathematical and scientific concepts.

Sample Lessons and Activities

This section provides information about NCDPI resources, a sample high school lesson, and four sample scenarios addressing the *Mathematics Standard Course of Study* and the NCHSEE. The materials identified illustrate how many of the objectives tested on the exam are inherent to mathematics instruction. However, it should be noted that not all the NCHSEE objectives lend themselves to reinforcement in mathematics.

To help students be successful on the NCHSEE, teachers will want to develop and/or adapt their own lessons and/or activities to reflect the Standard Course of Study and the matching competencies on the exam.

Resources

The mathematics staff of NCDPI has a number of resources available that support the NCHSEE. All of these resources can be downloaded from the Instructional Resources section of the NCDPI Math web site (http://www.learnnc.org/ dpi/instserv.nsf/Category7). Each provides many problems and activities.

- *Resources for Algebra* (also available from NCDPI Publications)
- Indicators for High School Mathematics
- Grade 6, 7, 8 Week by Week Essentials (also available from NCDPI Publications)
- Problem Solving Decks (Set C)

Sample Lesson

Adapted from "Scoring and Winning", *Resources for Algebra* (NCDPI, 1999)

Students work in pairs in two larger groups. Students will use the data from the 2001 NFL season to create scatter plots and find lines of best fit. Students will discuss the characteristics of those lines and make predictions.

- Divide the class into two groups. One group will be responsible for offense and the other defense.
- Have each group enter the set of ordered pairs (scoring, wins or losses) into the calculator and graph. Describe the scatter plot.
- Discuss the results and write a brief description.
- Discuss independent and dependent quantities. Do wins depend upon scoring or does scoring depend upon winning?
- Calculate the average scoring margin for each team (offense minus defense). What does a negative scoring margin mean?
- Have the class enter the set of ordered pairs (scoring margin, wins) into the calculator and graph. Describe the scatter plot.
- Have students graph by hand their data (offense, defense, or scoring margin). Then, using a straight edge, fit a line in the set of ordered pairs. Have several students use a transparency of the coordinate grid to plot their data. At the overhead, place or draw a line "fitting" the ordered pairs. Among the three graphs (offense, defense, or scoring margin), which set of data is "most" linear"? Explain.
- If a football team wins 14 games, how many points should it average on offense? Defense? By how many points should the team win?
- Which of these is the most accurate prediction? Why?
- What about the team that goes undefeated (16 wins)? No wins?

Other Activities in *Resources for Algebra* with detailed lesson ideas similar to this one include: Gulliver's Clothes, The Wave, How Do You Measure Up?, What Shape Are You?, It's All Downhill From Here, Estimating Fish Population, and Basketball.

The NCHSEE Format

Sample Scenarios

Scenarios will be used in the exam to setup items addressing the objectives of all four domains. They are anchored in real-life situations and incorporate authentic texts, such as maps, charts, instruction manuals, labels, articles, advertisements, reports, statistical data, speeches, historical and legal documents, and traditional literature. For each scenario, students will be presented with text, graphs, charts, etc. related to a theme, situation, and/or dilemma and will be asked questions related to the material.

Encourage students to ask themselves these kinds of questions as they work the samples and when they tackle their regular assignments.

What kinds of things are being asked?

Is the vocabulary clear?

Which information is important?

Did I estimate the correct answer before working the problem?

Did I eliminate obvious wrong answers?

Did I use any formulas correctly?

Did I leave out steps?

Did I use the appropriate numbers or operations?

Did I work backwards, plugging in my answer to make sure it fits?

The following scenarios and problems are adapted from *Resources for Algebra* and Indicators for High School Mathematics.

Answers (pp. 5-9): C; D; C; B; B; C; D; B; B; A; B; D; C

The matrix below displays the calories used per minute by body weight during several fitness activities.

Weight (lbs.)	100	120	150	170	200	220
Walking (15 min/mile)	3.9	4.6	5.8	6.6	7.8	8.5
Jogging (11 min/mile)	6.1	7.3	9.1	10.4	12.2	13.4
Running (8 min/mile)	9.4	11.3	14.1	16.0	18.8	20.7

1. Describe the change in calories used by the body as weight increases.
   A. random, no pattern
   B. decreasing
   C. increasing
   D. constant

2. Each morning George jogs through his neighborhood. If he weighs 165 pounds, how many calories is he using per minute?
   A. 9.2
   B. 9.5
   C. 9.8
   D. 10.1

3. After school each day Amy walks the track. If she weighs 125 pounds and moves at a rate of 14 minutes per mile, how many calories does she use on a three-mile walk?
   A. 300
   B. 269
   C. 231
   D. 207

Income Tax Schedules for Single Taxpayers in 2001.

North Carolina Tax Schedule

Taxable Income is more than	but not over	Tax is
$0	$12,750	6% of the taxable income
12,750	60,000	$765 + 7% of the amount over $12,750
60,000	120,000	$4,072.50 + 7.75% of the amount over $60,000
120,000	----------	$8,722.50 + 8.25% of the amount over $120,000

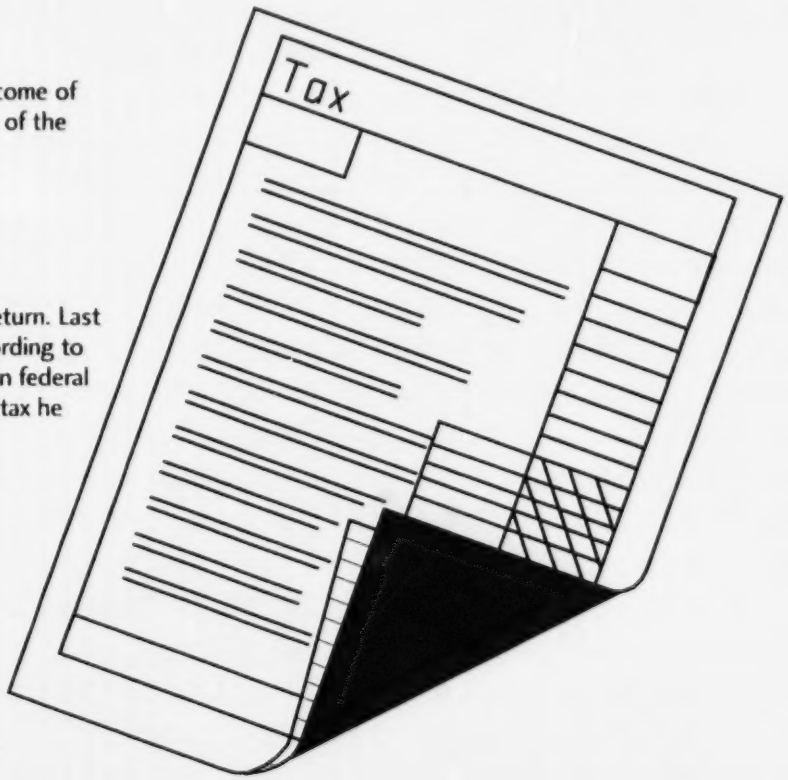
Federal Tax Schedule

Taxable Income is more than	but not over	Tax is
$0	$27,050	15% of the taxable income
27,050	65,550	$4,057.50 + 27.5% of the amount over $27,050
65,550	136,750	$14,645.00 + 30.5% of the amount over $65,550
136,750	297,350	$36,361.00 + 35.5% of the amount over $136,750
297,350	---------	$93,374.00 + 39.1% of the amount over $297,350

4. Linda was filling out her state income tax return. Her taxable income for the past year was $27,544. Determine the amount of state tax she owes.
   A. $1928.08
   B. $1800.58
   C. $1652.64
   D. $1035.58

5. Determine the total tax owed for a taxable income of $30,000. The total tax owed is what portion of the taxable income?
   A. 16.2%
   B. 22.8%
   C. 30.1%
   D. 34.5%

6. Danny was filling out his federal income tax return. Last year he had taxable income of $27,489. According to his records, Danny has already paid $4,900 in federal income tax. Determine the amount of federal tax he owes or should be refunded.
   A. owes $6732.10
   B. owes $2659.48
   C. refund of $721.77
   D. refund of $776.65



Winter Olympics: Participation

Olympic Year	Host Country	Men Competing	Women Competing	Nations Competing
1924	France	245	13	16
1928	Switzerland	438	26	25
1932	United States	231	21	17
1936	Germany	588	80	28
1948	Switzerland	529	77	28
1952	Norway	585	109	30
1956	Italy	688	132	32
1960	United States	522	143	30
1964	Austria	891	200	36
1968	France	947	211	37
1972	Japan	800	206	35
1976	Austria	892	231	37
1980	United States	839	233	37
1984	Yugoslavia	1,000	274	49
1988	Canada	1,110	313	57
1992	France	1,313	488	64
1994	Norway	1,474	531	64
1998	Japan	1,488	814	72
2002	United States			

Use the chart (see previous page) and graph to answer the following questions.

7. Women's participation is growing *faster* than men's during which interval?
   A. 1948-1956
   B. 1960-1968
   C. 1980-1988
   D. 1992-1998

8. The *least* change in total participation occurred in which interval?
   A. 1924-1932
   B. 1936-1960
   C. 1964-1976
   D. 1968-1980

9. Assuming the Olympics is an annual event, in which interval does men's participation *increase* the most annually?
   A. 1936-1956
   B. 1956-1972
   C. 1972-1980
   D. 1994-1998

Transportation costs vary with the mode of travel and the distance traveled. For example:

	Distance (round trip)	Car (up to 4 passengers)	Air (per passenger)	Rail (per passenger)
Raleigh-Charlotte	300 miles	$109.50	$377	$42
Raleigh-New York	1300 miles	$474.50	$112	$256

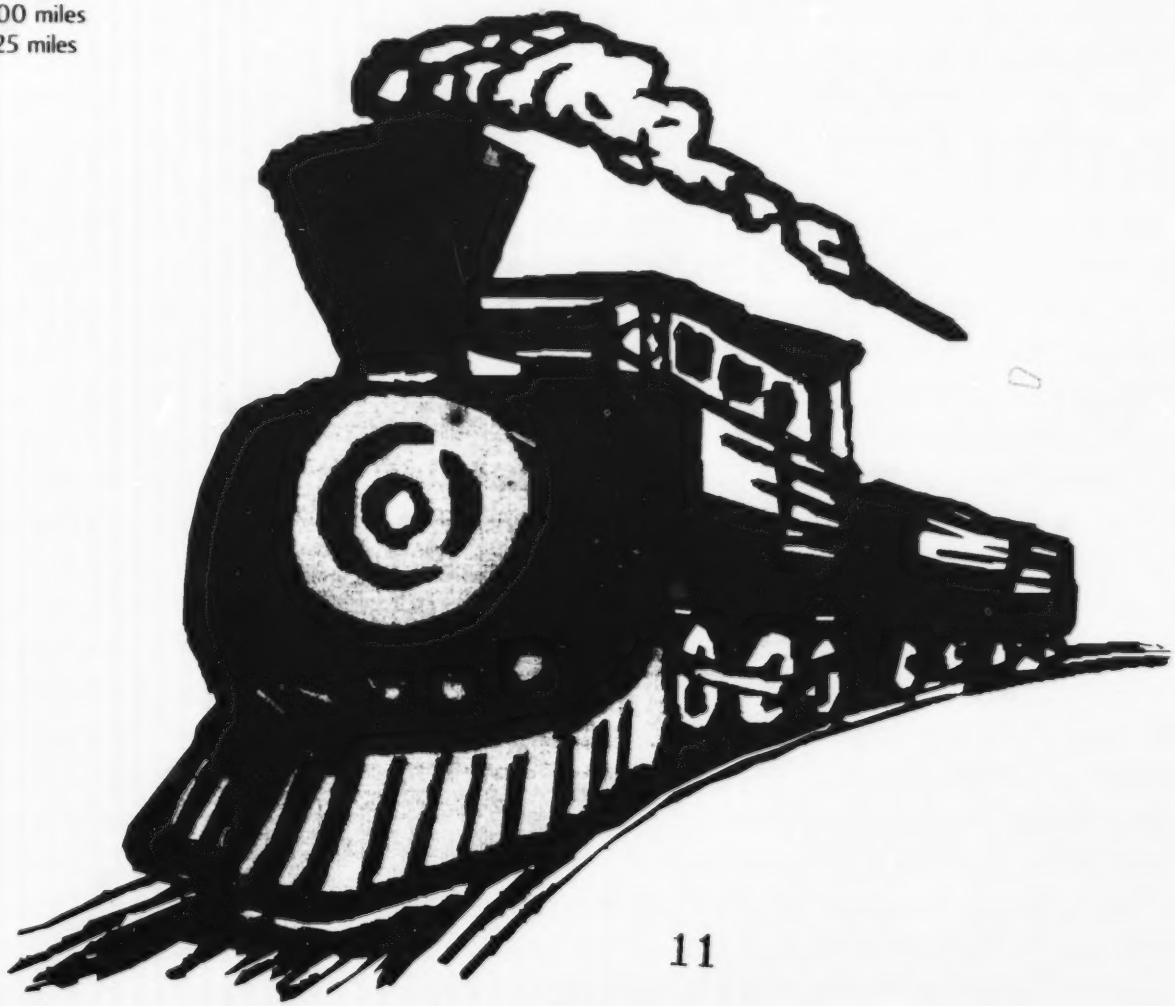
Assume that the costs are linearly dependent upon the distance traveled. Use the data provided to answer the following questions.

10. For what distances is the train the most expensive mode of travel for **one** passenger?
    A. never
    B. less than 105 miles
    C. between 725 and 1000 miles
    D. greater than 1000 miles

11. At what distance are car and air costs *approximately* the same for **one** passenger?
    A. 105 miles
    B. 725 miles
    C. 1000 miles
    D. 1725 miles

12. Approximately how much more is the cost per mile for rail than car for **two** passengers?
    A. 28¢
    B. 21¢
    C. 16¢
    D. 6¢

13. For a trip of 800 miles, how much less is travel by car for **six** people than by air?
    A. $310
    B. $584
    C. $883
    D. $1467



11

WEB RESOURCES

NCDPI Mathematics
www.learnnc.org/dpi/instserv.nsf/Category7

LearnNC
www.learnnc.org

NC Wise Owl
www.ncwiseowl.org

Teachers Connect
www.teachers-connect.net

The Gateway for Educational Materials
www.thegateway.org

National Council of Teachers of Mathematics
www.nctm.org
Members have access to journals and other resources.

Index of Federal Agencies
www.firstgov.gov/Agencies/Federal/All_Agencies/index.shtml
Almost every federal agency publishes educational materials. Two of the most popular are:

NASA Educational Programs
education.nasa.gov

US Census Bureau Teaching Materials
census.gov/dmd/www/schmat1.html

Mathematics for Decision Making in Industry and Government
mie.eng.wayne.edu/faculty/chelst/informs/

Applied Academics: Mathematics (British Columbia Ministry of Education)
www.bced.gov.bc.ca/careers/aa/lessons/math.htm

The Math Forum
mathforum.org

US Olympic Committee
www.usoc.org

PBS Teacher Source – Math
www.pbs.org/teachersource/math.htm

Library of the Workplace
cord.org/workplacelibrary/

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